



NASA SBIR 2012 Phase I Solicitation

H3.04 Thermal Control Systems

Lead Center: JSC

Participating Center(s): GRC, GSFC, JPL, KSC, LaRC, MSFC

Future human spacecraft will venture far beyond the relatively benign environment of low Earth orbit. They will transit through the deep space, but they may encounter warm transient environments such as low lunar orbit. Some spacecraft elements may be launched untended and would operate at relatively low power levels as they transit to their final destination. The combination of extreme environments and high turndown capability will be a major challenge for spacecraft Active Thermal Control Systems (ATCSs). Sophisticated thermal control systems will be required that can dissipate a wide range of heat loads in widely varying environments while using fewer of the limited spacecraft mass, volume and power resources. Advances are sought for microgravity room temperature thermal control in the areas of:

- Innovative thermal components and system architectures that are capable of operating over a wide range of heat loads in varying environments (for example, a 5:1 heat load range in environments ranging from 0 to 275 K).
- Two-phase heat transfer components and system architectures will allow the efficient acquisition, transport, and rejection of waste heat.
- Heat rejection strategies and hardware for transient, cyclical applications - e. g., phase change material heat exchangers, heat pumps, or efficient evaporative heat sinks.
- Smaller, lighter, high performance heat exchangers and coldplates.
- Low temperature external working fluids (a temperature limit approaching 150K) with favorable thermophysical properties - e. g., high specific heat, high thermal conductivity, and viscosity that does not dramatically increase at lower temperatures.
- Internal working fluids that are non-toxic, have favorable thermophysical properties, and are compatible with aluminum tubing (i.e., no corrosion for up to 10 years). Low temperature limits (~150 K) and favorable thermophysical properties would allow their use externally in a single loop ATCS.
- Low mass, high conductance ratio thermal switches.
- Long-life, light-weight, efficient single-phase pumps capable of producing relatively high pressure heads (~4 atm).
- Variable area radiators (e.g., variable conductance heat pipe radiators or drainable radiators).

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- New thermal design tools to reduce the time and costs required for analysis, design, integration, and testing of the spacecraft. In particular, an innovative thermal design tool capable of fast and accurate spacecraft thermal modeling with significantly reduced effort and cost is needed.

Technology Readiness Levels (TRL) of 2 to 4 or higher are sought.

Potential NASA Customers include:

- Orion Multipurpose Crew Vehicle (http://www.nasa.gov/mission_pages/constellation/orion/index.html)

Future Human Space Missions - (<http://www.nasa.gov/exploration/home/index.html>)